



Dodecahedron Lamp

Written By: Charles Platt



TOOLS:

- [Hand riveter \(1\)](#)
- [Metal shears \(1\)](#)
- [Soldering iron \(1\)](#)
[30W minimum](#)



PARTS:

- [Straws \(12\)](#)
- [Duct tape \(6\)](#)
- [Wire \(1\)](#)
- [Electrical ring terminals \(60\)](#)
[Within this terminal size specification, if you find a choice of ring sizes, select the ones with the smallest holes.](#)
- [Wood \(1\)](#)
- [Nails \(2\)](#)
- [Bolts \(20\)](#)
- [Plywood \(1\)](#)
- [Lamp socket \(1\)](#)
[I made mine out of ABS.](#)
- [Aluminum sheet \(1\)](#)
- [Rivets \(120\)](#)
- [Polycarbonate film \(1\)](#)
[from http://mcmaster.com](#)
- [Adhesive \(1\)](#)
[like 5-minute epoxy](#)

SUMMARY

People appear symmetrical, but even the most perfect human face shows irregularities if we compare the left side with the right. Perhaps this is why the absolute, rigid symmetry of crystals seems beautiful yet alien to us. Unlike DNA's soft spiral, a crystal's molecular bonds align themselves to form regular three-dimensional structures, which the Greeks considered mathematically pure. The most fundamental of these shapes are known as the five Platonic solids.

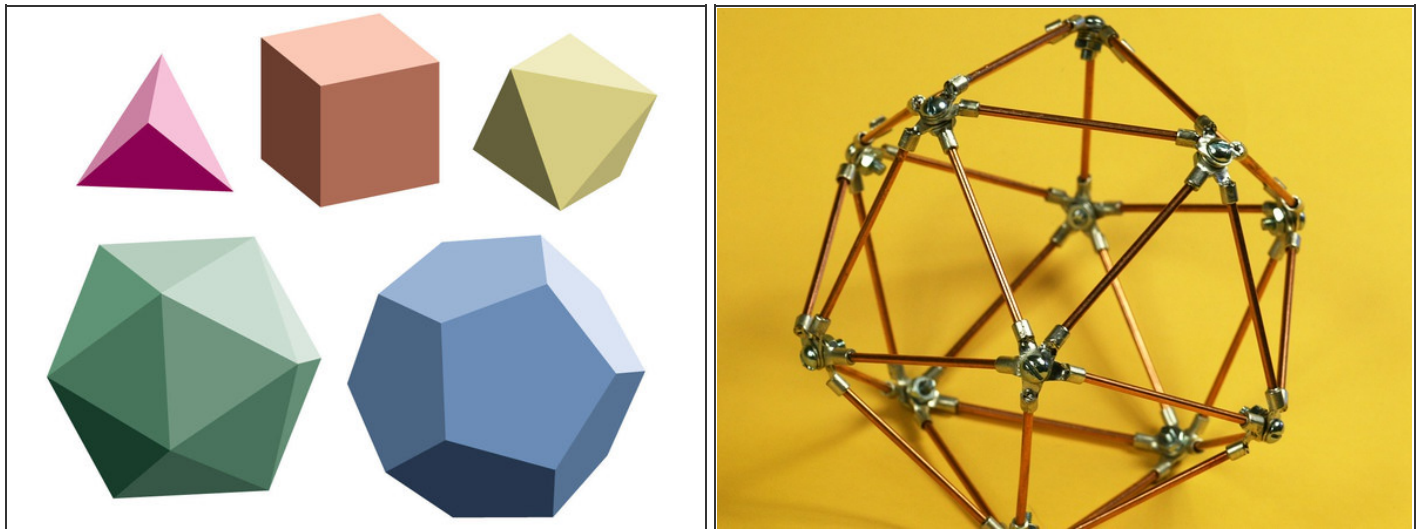
If you assemble equal-sided triangles — all the same size, with the same angles to each other — you can create three possible solids: a tetrahedron (with 4 faces), an octahedron (8 faces), and an icosahedron (20 faces). If you use squares instead of triangles, you can create only a hexahedron, commonly known as a cube. Pentagons create a dodecahedron (12 faces), and that's as far as we can go. No other solid objects can be built with all-identical, equal-sided, equal-angled polygons.

The Platonic solids have always fascinated me. My favorite is the dodecahedron, which is why I used it in this project as the basis for a table lamp. By extending its edges to form points, we make something that looks not only mathematically perfect, but perhaps a little magical.

Step 1 — Start with a crystal.

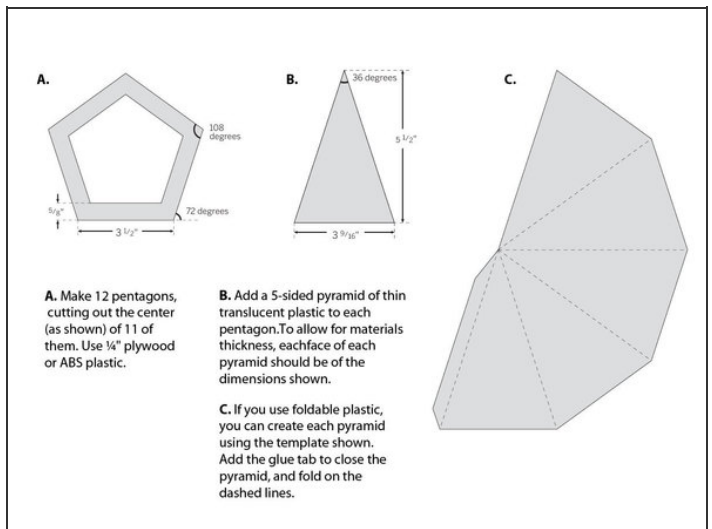
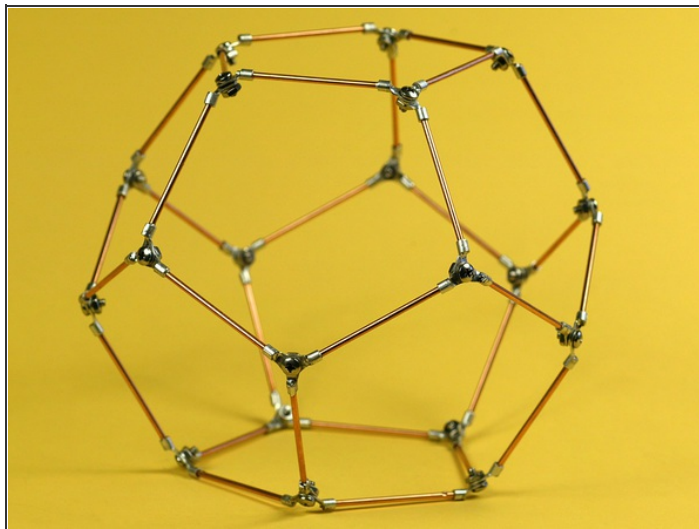


- Because none of the Platonic solids, except for the cube, contains obvious 90° angles, building them is a counterintuitive, mind-bending experience. Before we get to the dodecahedron, let's warm up with something simpler: an octahedron.
- You can make this in a few minutes using 12 plastic cocktail straws and 6 squares of duct tape, laying them out as in the diagram. Circle the straws around so that point A sticks to point B. The squares of tape should bend like hinges while the straws remain straight.
- Now hinge the vertical straws so that their points C all meet together at point D. Again, keep the straws rigid, and flex the tape. Turn the structure upside down, bring points E to point F, and the result should look like photos 2 and 3. To prevent the straws from coming unstuck, you can bend the tape inward so that it sticks to itself.
- Octahedrons are a common structure on the molecular scale, and because a crystal grows by repeating itself, tiny octahedrons assemble to form big ones. Search for "crystal octahedron" on eBay, and you'll discover that rockhounds know all about Platonic solids.
- Notice how rigid your drinking-straw octahedron is. In fact, its shape is so efficient that it can support as much as 1,000 times its own weight. This suggests how rocks and metals achieve their strength.

Step 2 — From 8 to 20 to 12.

- The five Platonic solids are tetrahedrons (4 sides), hexahedrons (6 sides), octahedrons (8 sides), icosahedrons (20 sides), and dodecahedrons (12 sides).
- Let's try something a little more permanent than drinking straws and duct tape. You'll need 8' of 10-gauge, solid copper wire, and 60 electrical ring terminals, size 12–10. (Within this terminal size specification, if you find a choice of ring sizes, select the ones with the smallest holes.)
- Begin by hammering a couple of finishing nails, $3\frac{3}{4}$ " apart, into a block of scrap wood. Now cut a piece of wire 3" in length, use pliers to pull the plastic shields off 2 ring terminals, and slip the terminals onto the ends of the wire. Place the assembly over the nails to hold everything in position, and solder the terminals onto the wire with a 30W (minimum) soldering iron.
- After you do this 30 times, you'll have enough components to build the icosahedron shown. You can use $\frac{3}{8}$ " #10 bolts to join the ring terminals, which you'll have to bend slightly to make them align with each other.

Step 3



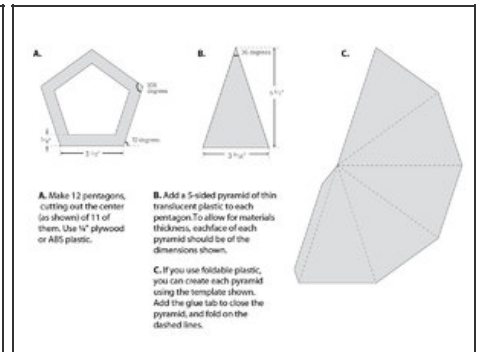
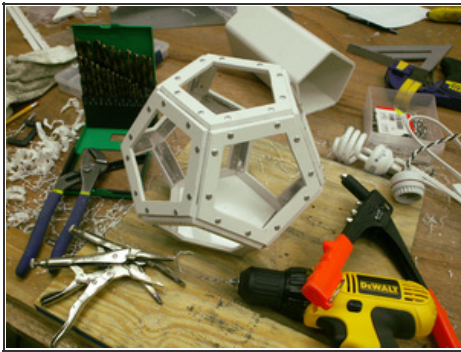
- Now here's the interesting part: if you disassemble the icosahedron, you can build the dodecahedron in the photo using exactly the same number of pieces of wire because both solids have the same number of edges.
- You'll find that the icosahedron is very easy to build, as the triangles cannot be deformed. The dodecahedron is very difficult because its pentagonal sides collapse easily. Therefore we'll need to fabricate our dodecahedral table lamp from a material that has its own rigidity, such as plywood or (my personal preference) ABS plastic (see [Plastic Fantastic Desk Set](#) for an intro to working with ABS).
- Since we'll put a cool-burning fluorescent bulb inside the lamp to avoid overheating it, our dodecahedron must be big enough to contain the bulb. The suggested minimum dimensions are shown in photo 2.
- If you're wondering how to cut a symmetrical pentagon, there's an easy way and there's a harder way. The easy way is to draw a pentagon using vector-graphics software such as Adobe Illustrator, then print the pentagon and use it as a template. (Old versions of Illustrator are cheaply available on eBay and will run on Windows versions up to XP.)
- The harder way is to use a pencil, paper, and protractor. Whichever way you do it, the inside angle at each point is 108° , and each side is angled 72° from each previous side. ([CRAFT magazine, Volume 04, page 96, "Repeating Splendor."](#) has step-by-step instructions for drawing polygons with any number of sides.)

Step 4 — Constructing the lamp.



- You will need 12 pentagons. I used a band saw to cut them out of plastic sheet, but a handsaw is almost as quick. Bevel the edges with a sander or metal file so that when we add points to the solid (see below) they'll fit nicely. Use a jigsaw to cut out the centers of your pentagons, except for the last one, in which you will drill a hole for your lamp socket, before you mount it on the base of the lamp. I made the base by bending ABS, but you should use anything that appeals to you.
- To assemble your pentagons, you can join them edge-to-edge using brackets made from aluminum sheet. My local hardware store had some very thin, precut aluminum, which was ideal. Use shears to take a few 1" strips from the sheet, chop each strip into pieces 2½" long, and bend each piece lengthways in a vise to make the brackets. A quick way to attach the brackets to the pentagons is with 1/8" aluminum rivets and a hand riveter tool.

Step 5 — Adding points.



- When your dodecahedron is complete, it should look like the one in the photo. The final step is to stellate it, which means adding points to give it a star shape. Imagine the edges of each pentagon extended outward, and eventually they will intersect at points.
- Each point will be a little 5-sided, hollow-based pyramid attached to one of the pentagons in the body of your lamp. You can make the pyramids using 0.01" polycarbonate film with a velvet finish from <http://mcmaster.com>, vellum from your local craft store, or any other translucent paper or plastic that is foldable.
- Copy the 5-sided template in the diagram and fold along the lines to make one stellation. The only problem with this scheme is that the glue tab to complete the process will show as a shadow when the light is on.
- For a cleaner result you can fabricate each pyramid from five separate triangles using a thicker, rigid plastic (such as milky-white 1" acrylic) and join the triangles edge-to-edge with solvent glue or epoxy. Either way, to attach the stellations to the dodecahedron, use any clear adhesive such as 5-minute epoxy.
- In the mathematical realm, the object you have constructed is considered a very pure and perfect form. In the physical universe, its perfection will depend on your proficiency with tools and glue. Either way, if people ask you what it is, you should have your answer ready: "Oh, that's just my stellated dodecahedron." And if someone needs to know what a dodecahedron is, you have another easy answer: "The fifth Platonic solid. What else?"

For more fun with Platonic solids, check out our Weekend Project on Picnic Geometry and learn how to make an icosahedron out of paper plates: http://makezine.com/go/picnic_geometry

This project first appeared in [MAKE Volume 11](#), page 164.

